CAREERS IN PHY

Careers in Physics

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What is Physics?

Physics can be defined as the science of matter and energy, and of interactions between the two. Physics deals with the physical properties, processes, or laws governing these interactions, through the study of the natural world and phenomena.

Physicists want to thoroughly understand how the world works, in every detail and at the deepest level. This includes everything from elementary particles to nuclei, atoms, molecules, macromolecules, living cells, solids, liquids, gases, plasmas, living organisms, the human brain, complex systems, supercomputers, the atmosphere, planets, stars, galaxies, and the universe itself. Physicists study many of today's important scientific and technological questions, developing new instrumentation, refining measurement techniques, and modelling. The latter constitute the discipline of applied physics. With mathematics and chemistry it is commonly known as an "enabling science" because it forms the basis for many of the professional disciplines, and increasingly commercial ones.

Why Study Physics?

The study of Physics is traditionally grouped into fields such as acoustics, optics, mechanics, thermodynamics, and electromagnetism, as well as in modern extensions including atomic and nuclear physics, cryogenics, solid-state physics, particle physics, and plasma physics. There are a number of reasons to study physics, not only to enhance career prospects, but also for reasons of personal development.

On a Personal Level

A physics education emphasises problem-solving and abstract thinking and this training makes physics graduates very desirable employees in a wide variety of areas. Physics graduates can go on to work in high tech companies, where training in practical subjects such as optics, lasers, computer interfacing, image processing and electronics can also heighten their appeal.

Personal qualities which the study of physics requires include curiosity, imagination, inventiveness and, above all, honesty in dealing with data, theory and colleagues. An ability to communicate one's ideas in spoken and written form is essential and should be developed. The enjoyment of problem-solving and working with mathematics and computers is also important.

On a "Big Picture" Level

Physics is an international enterprise which plays a key role in the future progress of humankind. Physics education and research are important, and an exciting intellectual adventure which expands the frontiers of our knowledge about Nature. Physics generates fundamental knowledge needed for the future technological advances that will drive the economic engines of the world, as well as contributing to the technological infrastructure and providing the training needed to take advantage of scientific advances and discoveries.

Physics also improves our quality of life by providing the basic understanding necessary for developing new instrumentation and techniques for medical applications, such as computer tomography, magnetic resonance imaging, positron emission tomography, ultrasonic imaging, and laser surgery.

What Types of Physics Can I Study?

The range of areas which can be studied in physics courses is quite large, and includes:

Astrophysics, Chemical Physics, Computational Physics, Condensed Matter Physics Electromagnetism, Fluid Mechanics, Geophysics, Laser Physics, Mathematical Geophysics, Mathematical Physics, Medical Physics, Nuclear Physics, Optics, Quantum Physics, Radiation Physics, Physical Electronics, Semiconductor Physics, Theoretical Physics, Thermodynamics and Wave Motion. For more information about these courses, visit some of the links listed on the last page of this profile.

Physics Degrees are often combined with Engineering to gain a double degree. It broadens the range of employment options and gives entry to a wider range of post-graduate studies.

Where Can I Study Physics?

Most Australian Universities offer bachelor and postgraduate degrees which are either physics-based, or contain a significant degree of physics, and these can range from medical radiation physics, optoelectronics or geophysics, to combined degrees such as Science/Asian Studies, Science/Law or Business/Science. The complete list of Australian tertiary institutions offering courses with physics components includes:

Australian Defence Force Academy
Australian National University
Avondale College
Central Queensland University
Curtin University of Technology
Edith Cowan University
Flinders University of South Australia
Griffith University
James Cook University
La Trobe University
Macquarie University
Monash University
Murdoch University
Northern Territory University
Queensland University of Technology
RMIT University
Swinburne University of Technology
University of Adelaide
University of Canberra
University of Melbourne
University of New England
University of New South Wales
University of Newcastle
University of Queensland
University of Southern Queensland
University of Sydney
University of Tasmania
University of Technology, Sydney
University of Western Australia
University of Western Sydney
University of Wollongong
Victoria University

Check out *www.dest.gov.au/tenfields* or *www.thegoodguides.com.au/searchguide.cfm* for more course information. You should then visit the homepages of universities whose Physics courses you are interested in – a full list can be found on *gradlink*. Go to *www.gradlink.edu.au* and click on the "Campus Contacts" tile.

Where Can I Go with a Physics Degree?

How Do Different Levels of Study Translate into Employment?

Generally speaking, a bachelor degree involving physics will qualify you for positions such as research assistant, high level technician, computer specialist or engineer, as well as non-technical work in publishing and sales, however postgraduate degrees will allow for more responsibility and advancement. Remember also that some organisations will train you in their particular area of industry, for example manufacturing electrical devices.

It is always a good idea to combine a basic physics degree with further training. Post Doctoral training is highly regarded by many employers and is necessary for teaching positions in Universities.

Teaching Physics

To teach secondary students you will need a bachelor degree in addition to educational certification/licensure, and you can also pursue postgraduate degrees in other areas such as law, business and accounting to add to your employability.

There are many areas of work and research accessible to those who have studied physics, including:

Astronomy – teaching, research, writing

Astronomy is the the study of objects and matter outside the earth's atmosphere, particularly their physical and chemical properties; physics is a vital part of astronomy and a specialised group of physicists are often referred to as "astrophysicists". Some sub-fields include Cosmologists, Astrometrists, Planetologists, Radio Astronomers and Mathematical Astronomers.

Acoustical Physics – Research/Development, Testing, Teaching, Consulting, Administration

Acoustical Physics is the "Science of Sound"; acoustical physicists work in fields relating to physical, biological and technical acoustics and the sense of hearing.

Astrophysics – Teaching, R&D, Consulting, Astronautics, Administration

Astrophysicists explore the fundamental processes of the universe which underpin astronomical research and the practical use of space. Astrophysics enhances understanding of the universe as a whole and therefore of the environment within which space vehicles and the earth operate.

Biophysics – Teaching, Basic and Applied R&D, Consulting, Administration

Biophysics is the scientific study of the physics of organisms and biological structure and processes; it is the understanding of physical processes as they relate to biological systems, and the application of physical tools to solve biological problems. At a basic level it underlies molecular biology.

Condensed Matter Physics – Research/Development, Testing, Teaching, Consulting, Administration

Condensed Matter Physics refers to the body of scientific knowledge about the characteristics displayed by different classes of liquids and solids. The uses of this knowledge range from pure applications such as investigating the quantum mechanics of solids, to practical applications like the manufacture of computer chips.

Fluid and Plasma Physics – Teaching, Basic and Applied R&D, Consulting, Administration

Fluid Physics is the study of the motion of fluids and the effects of this motion, and Plasma Physics is the study of plasmas – quasi-neutral gases of charged and neutral particles which exhibit collective behaviour. Fluid and Plasma Physics are vital to understanding, controlling, and improving many of our industrial and natural processes.

Geophysics – Teaching, Basic and Applied R&D, Consulting, Administration, Exploration

Geophysics involves the application of physical theories and measurements to discover the properties of the earth. Some sub-fields include seismology, hydrology, meteorology, engineering geophysics, petrophysics and mineral exploration.

Health Physics – Teaching, Basic and Applied R&D, Consulting, Administration, Exploration

Health physicists investigate principles by which nuclear and other radiation interacts with matter and living systems, studying environmental levels of radioactivity and the effects on biological systems. Different areas of employment include Power Reactor Health Physicists, Medical Health Physicists, Nuclear Weapons Health Physicists, and those in Regulatory Enforcement and Occupational Safety, Education and the Environment. It also includes the control of noise and atmospheric pollution.

Medical Physics – Teaching, Basic and Applied R&D, Consulting, Administration

Medical physics applies the principles of various branches of physics to the diagnosis and treatment of human disease. Subfields include Radiation Oncology, Diagnostic Radiology and Nuclear Medicine. In 2001-2002 Medical Physics was the fastest-growing Physics discipline in Australia.

Nuclear Physics – Teaching, Basic and Applied R&D, Consulting, Administration, Training, Quality Control, Operation and Maintenance, Law

Nuclear physics is the study of the properties of the nucleus and the forces that hold the nucleus together. Some nuclear physicists specialise in the use of radioactive materials for diagnosing and treating medical conditions.

Optical Physics – Teaching, Basic and Applied R&D, Consulting, Administration

Optical physics is concerned with light controlling matter and vice versa, in areas ranging from the manipulation of atoms to information processing. It forms the basis for optoelectonics.

Science Education – Teaching, Software development, Educational Research, Writing and Editing, Public Relations, Library and Information Services

Teaching and informing others about Science is one of the most important roles in the field, and one of the fastest growing; physics is at the heart of much scientific endeavour.

Technical – Engineering, Quality Control, Industrial Hygiene, Design Development, Technical Writing, IT, Research Associate/Assistant. The range of technical positions available for physicists continues to diversify and expand around the world.

Will I Get a Job?

While employment opportunities for physicists can vary from year to year and according to different regions, they are nevertheless quite promising in 2003. The number of advertised jobs for which a degree or diploma in Physics or Applied Physics is a requirement has increased steadily over the past few years; from 470 in 1999, to 540 in 2000 and to 655 in 2001. In 2001, 78.3% of physics bachelor degree graduates were in full time employment, while 100% of those with a graduate certificate or diploma were in full time work, and 83% of those with a PhD were working full time. In 2003 the job market figures for physics students show that competition for a relatively stable level of jobs is heightening – resulting in a greater need for candidates to display transferable and generic skills, as well as areas of specialisation.

Who Recruits Physicists?

One of the major recruiters of physicists in Australia is the Commonwealth Government, and agencies such as the CSIRO *www.csiro.gov.au*, Bureau of Meteorology *www.bom.gov.au*, Australian Nuclear Science and Technology Organisation (ANSTO) *www.ansto.gov.au* and the Defence Department *www.defence.gov.au* provide many opportunities each year. The Higher Education sector also offers teaching, research and technical positions, while private sector positions can be broadly categorised into management/sales or other areas such as cooperative research. Secondary schools also stipulate physics as a prerequisite for a range of teaching positions; meanwhile some physicists who studied in Australia will take up research positions overseas.

Many opportunities are not advertised through general career vacancy channels (newspapers, job boards and the like). These include those offered by the Australian Institute of Physics (AIP) *www.aip.org.au/jobs.html* and the Australasian College of Physical Scientists and Engineers in Medicine *www.acpsem.org.au*, which are promoted via their website and professional journals; the Australian Research Council (ARC) *www.arc.gov.au* also offers many opportunities each year through its own channels. Additionally, some firms recruit on campus and do not advertise their positions in national or local newspapers; this is the case for example in optoelectronics.

Check out the links to professional bodies in your field of interest and location, by performing a search on *http://jobguide.dest.gov.au*

How Much Will I Be Paid?

Starting salaries data is collected each year by *gradlink* as part of the *Graduate Destination Survey*, the annual survey of graduates from all Australian universities four months after the completion of their studies. The findings of this research are collated and reproduced in a series of reports, as well as being made available on the Internet. In 2001, physics bachelor degree graduates earned a median salary of A$35,000 per year; additionally graduates with a Masters in Research earned A$50,000 and those with a PhD earned a A$47,000 median salary per annum. Further information about salary trends is available online at *www.gradlink.edu.au/gradsonline*, which looks at gender and state salary and employment levels, as well as comparing physical science salaries with other study areas.

According to research conducted by the University of Adelaide's Department of Physics, senior research positions can command up to A$87,000 per annum and professorial posts up to A$140,000; however an entry level position is more likely to be between A$30,000 and A$50,000 for a teaching, research assistant or analyst position.

What Can I Do to Find a Job?

As with any area of employment, initiative is the key to finding a position. Talk to your university faculty or careers service (see Campus Contacts on *www.gradlink.edu.au*) about contacting people in the field, and remember that networking is an ongoing, vital part of finding a job; visit government laboratories or research centres and talk with physicists about their work. You should also join professional associations, not merely because it will "look good on your résumé" but in order to further network and keep up to date with developments in the field, not to mention finding out about job vacancies which are not advertised anywhere else.

It is also important to ensure you concentrate on developing your oral and written communication skills, and the more experience you have with tools, electronics, machinery and computing, the better. Lastly, become familiar with the job application process for government jobs at all levels – federal, state and local. Be prepared to say why you believe you are the person best fitted for the job.

How Do I Find Work Experience?

Again, your first port of call should be your university's Careers Service, and/or your faculty or department, as employers offering work experience opportunities will often go through either of these channels; industrial placements may also be offered as part of your course of study. You can also check out some opportunities online – the Graduate Opportunities career search *www.graduateopportunities.com* and SEEK job search *www.seek.com.au* both contain listings for opportunities in Australia.

For a full list of employer program application dates, visit 2003 Application Closing Dates on *gradlink* in the "How To Find A Job/Important Dates And Contacts" section *www.gradlink.edu.au.*

You should also have a browse through the websites of the University of Adelaide Physics Department *www.physics.adelaide.edu.au* and the Australian Institute of Physics *www.aip.org.au*.

What About Scholarships and Awards?

The JASON (Joint Academic Scholarships Online Network) website *www.jason.unimelb.edu.au* is a searchable database of scholarships and awards in Australia. Again the Australian Institute of Physics website *www.aip.org.au/scholarships.html* and *www.aip.org.au/medals.html* and other Universities' Physics Departments are useful too – find a full list of Australian and New Zealand university websites under "Campus Contacts", accessible from the front page of *www.gradlink.edu.au.*

Do Postgraduate and Further Studies Lead to Better Job Opportunities?

Many job advertisements in the national/major newspapers for physicists call for an honours degree or a postgraduate qualification, while jobs which require only an ordinary degree or diploma in physics are mainly to be found in the local press. Further training or study is also considered important to a range of positions suited to physics graduates, such as teaching in secondary schools, or where a higher degree qualification is stated or implied in the advertisement.

Further Information

Australia – General Information and Jobs

• Australian Institute for High Energy Physics *www.ph.unimelb.edu.au/epp/aushep/aushep.html*

• Australian Institute of Physics *www.aip.org.au* see also *www.aip.org.au/aipbranches.html, www.aip.org.au/jobs.html*

• *gradlink* – Higher Education's Official Graduate Careers Website *www.gradlink.edu.au*

• University of Adelaide's Department of Physics and Mathematical Physics *www.physics.adelaide.edu.au*

International Jobs and Professional Associations:

• Health Physics Society Careers *www.hps.org/publicinformation/hpcareers.html*

• International Union of Pure and Applied Physics (IUPAP) *www.iupap.org/index.html*

• Institute of Physics (UK) *www.iop.org*

• NewScientistJobs.Com *www.newscientistjobs.com*

• Physics Web (UK) *http://physicsweb.org/jobs*

• Research Network (International, based in US) *www.researchnetwork.com/emplogin.cfm*

• TIP-TOP Dynamic Job List for Physicists *http://tiptop.iop.org*

• World of Physics *http://scienceworld.wolfram.com/physics*

Information for this profile was adapted from the following sources:

1. "Jobs in Physics in 2001: Much improved but uneven", by John Prescott, article available online at *www.physics.adelaide.edu.au/jobs/AIP_JobsReview01.html*

2. *Graduate Destination Survey*, Graduate Careers Council of Australia *www.gradlink.edu.au*

3. The Canadian Association for Physics Careers and Jobs *www.cap.ca/careers*

4. The International Union of Pure and Applied Physics (IUPAP) *www.iupap.org/index.html*

5. The Physics Department of the University of Adelaide *www.physics.adelaide.edu.au/index.html*

6. The CancerWeb Online Medical Dictionary *http://cancerweb.ncl.ac.uk/omd/index.html*

7. University of British Columbia Physics Department *www.physics.ubc.ca*

8. Society of Exploration Geophysicists *www.seg.org*

9. Careers Service of McDaniel College, MD (US) *www.wmdc.edu*

10. *Graduate Opportunities 2003* editorial, published by *gradlink* and The Good Guides Group.

Special thanks are extended to Professor John R. Prescott from the Physics/Mathematical Physics Department of the University of Adelaide.

Additional Reading

The Graduate Careers Council of Australia produces a range of publications including the *Graduate Destination Survey, Graduate Starting Salaries*, the *Course Experience Questionnaire*, the *Directory of Postgraduate Study*, and *Your Career and You*. These publications can be sourced from your university careers service and *gradlink*, or can in many cases be downloaded for free from the *gradlink* website: *www.gradlink.edu.au.*

This profile is intended for use by careers services in higher education in Australia, and will also be of use to secondary school students and others considering further study. A full list of *gradlink's* industry career profile booklets is available from *www.gradlink.edu.au*, or on request from the *gradlink* Helpdesk (details below).

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